614

ecology and environment, inc.
International Specialists in the Environment

Portland Office
333 SW Fifth Avenue, Suite 608
Portland, Oregon 97204
Tel: (503) 248-5600, Fax: (503) 248-5577

Technical Memorandum

To: Kevin Parrett, Project Manager (DEQ) -- McCormick and Baxter Superfund Site

Date: September 7, 2004

From: John Montgomery, Project Manager (E & E)

Subject: August 1, 2004 through August 31, 2004 Barrier Wall Performance Monitoring Monthly Report

1.0 Introduction

This technical memorandum presents a monthly status report on groundwater movement and nonaqueous phase liquid (NAPL) thickness results inside and outside the barrier wall at the McCormick and Baxter Creosoting Company, Portland Plant (McCormick and Baxter) site in Portland, Oregon. The technical memorandum presents hydraulic head measurements and gradients, groundwater contour maps, static water-level measurements, transducer plots, NAPL gauging and extraction results. The monitoring data was collected during the period from August 1, 2004 through August 31, 2004. Tables and figures are attached at the end of this technical memorandum.

The monitoring program at the McCormick and Baxter site is used to evaluate the functional performance of the containment system (the barrier wall) and to determine whether the containment system is performing the designed function. The purpose of this report is to provide data in support of the objectives and goals as defined in the monitoring plan. These include:

- Understand changes in groundwater flow outside and inside the barrier containment system;

DRAFT

- Understand changes in gradients/fluxes from the bluff to the river on the north and south sides of the containment system;

- Understand groundwater flow and contaminant movement along the riverfront downgradient of the containment system;

- Determine the effects of groundwater flow toward Willamette Cove in relation to existing NAPL seeps; and

- Determine the effects of river stage and tidal influence on groundwater levels and flow.

2.0 Water-Level Monitoring

Automated and Manual Water-Level Data Collection

Groundwater level data is currently being collected at the site from select monitoring wells using automated pressure transducers and manually operated electronic water-level indicators.

Approximately 96 monitoring wells were manually monitored during the reporting period to determine groundwater elevations and calculate gradients inside and outside the barrier wall. Twenty-four select monitoring wells are equipped with pressure transducers to collect water-level measurements at hourly intervals (Table 1). Data is currently downloaded at monthly intervals from each transducer location using a hand-held personal digital assistant or PDA.

On August 18, 2004 groundwater-level data was collected manually from 95 on-site wells and one off site well at low tide. Gauging began approximately 1 hour before low tide and was completed within 1 hour after low tide (e.g. during the tidal period that has the minimal water level change). The resultant data (Table 2) was used to construct a groundwater contour map and is provided as Figures 2a and 2b of this report.

The monitoring wells designated with an *s* (e.g., MW-36s) are wells screened in the shallow zone. Those wells designated with an *i* (e.g., MW-36i) are screened in the intermediate zone, and those wells designated with a *d* (e.g., MW-36d) are screened in the deep zone. Deep monitoring wells are screened beneath the base of the barrier wall. Figure 1 shows the locations of the monitoring well network.

River stage data are recorded daily from the Morrison Bridge and corrected to river stage adjacent to the McCormick and Baxter site [(Morrison Bridge data)-(0.1 ft)].

2.1 Groundwater Flow and Gradients

Figures 2a and 2b present groundwater contour maps representing conditions during low tide on August 18, 2004. Groundwater inside the wall continues to generally flow toward the FWDA. Horizontal gradients were calculated using both the contour elevations and the well elevations inside the barrier wall (see Figure 2a). The calculated horizontal gradient inside the wall for the current monitoring event is 0.001 ft/ft in the TFA and

gradient inside the wall for the current monitoring event is 0.001 ft/ft in the TFA and 0.007 ft/ft in the FWDA. Horizontal gradients were calculated for several different areas on site both inside and outside of the barrier wall, and are listed in Table 3. Groundwater outside the wall is diverted around the upland portion of the wall toward Willamette Cove and toward the southeastern portion of the site. In the FWDA, heads inside the wall were approximately 5 feet higher than heads outside the wall. In the TFA, heads inside the wall were approximately 6.4 feet higher than heads outside the wall. No significant changes were observed between July and August 2004.

Vertical groundwater gradients were calculated using manual and transducer data from August 18, 2004 for several of the nested wells installed inside and outside the barrier wall. Table 4 presents the calculated vertical gradients between the shallow, intermediate and deep aquifer zones during low tide. Vertical gradients at low tide are generally down inside and outside of the wall in both the FWDA (wells 36, 37, 40, 41) and the TFA (44 and 45).

2.2 Transducer Plots

Transducer plots were developed for select monitoring wells (MW-36s, MW-37s, MW-44s and MW-45s) inside and outside the barrier wall during the reporting period (Figures 4 and 5, respectively). The shallow aquifer plots compare monthly water-level elevations inside the barrier wall versus water-level elevations outside the barrier wall, river elevation, and precipitation data. Water levels outside the wall correlate well with river stage along the riverfront portion of the barrier wall. Water levels in shallow wells located inside the wall in the FWDA and the TFA appeared to be declining.

3.0 NAPL Thickness and Extraction

Light non-aqueous phase liquid (LNAPL) and dense non-aqueous liquid (DNAPL) measurements were recorded at several site wells during the reporting period. Currently, 24 monitoring wells in the TFA and the FWDA are measured for NAPL thickness on a weekly basis. When LNAPL exceeding 0.4 ft thickness is encountered during routine monitoring, it is manually extracted using passive skimmers or bailers. When DNAPL exceeding 1.0 ft thickness is encountered during monitoring, it is extracted using pneumatic pumps. A significant amount of DNAPL was extracted from select wells during the reporting period.

In response to increased DNAPL volumes, E & E installed a temporary DNAPL extraction system on August 27th, 2004 to extract DNAPL from monitoring wells MW-Ds, MW-20i, EW-9s, MW-Gs, and EW-2s. The system was installed in an effort to increase the volume of DNAPL extracted. The system is constructed largely from existing equipment utilized in the previous groundwater extraction system. The system is comprised of dedicated pneumatic pumps in each of the wells listed above which are powered by an existing air compressor. A separate pump controller individually controls each pump. Individual pumping rates are established based on the DNAPL thickness in the well, which is measured daily. Typical pumping rates are between approximately 2 to 7 gallons per hour for 2 to 5 hours per day. Pumping durations are based on visual observation of extracted product (e.g. the presence of water in the discharge). Optimal

pumping rates and durations are still being evaluated and are adjusted on a daily basis. An automatic timer has been installed on the air compressor to prevent continuous pumping of the wells. This was added as a safety feature to reduce the volume of water extracted and to prevent potential overflow of the storage drums. For example, the timer prevents the system from operating overnight, if the system is not shut down manually each day. Extracted DNAPL is stored in well specific 55-gallon drums located in an existing containment area. Discharge hoses are securely connected to individual drums using quick connect fittings. DNAPL thickness is measured each morning before the system is turned on. Extracted DNAPL and water volumes for individual wells are calculated on a weekly basis.

Clean wells (wells not containing NAPL) are gauged on a monthly basis for water levels and total depths, and to verify that NAPL has not infiltrated these wells. Figure 2 shows the locations of monitoring wells that have exhibited measurable thicknesses of LNAPL and/or DNAPL during August 2004.

LNAPL

The measured LNAPL thicknesses ranged from 0.01 feet to 3.66 feet in on-site wells. Ten wells in the FWDA, five wells in the TFA, and one well near the shop exhibited measurable thicknesses of LNAPL during this reporting period (Table 5). Five of these exhibited thicknesses of only 0.01 feet. LNAPL thicknesses measured in August 2004 were generally consistent with thicknesses measured in previous months.

DNAPL

Measurable DNAPL was recorded in eleven wells during the reporting period. The measured DNAPL thicknesses ranged from 0.22 feet to 3.80 feet in on site wells. Six wells in the FWDA, four wells in the TFA, and one well located near the shop building contained DNAPL during this reporting period (Table 5). DNAPL thickness has decreased significantly in monitoring wells MW-20i and MW-Ds due to increased extraction rates, between reporting periods July 2004 to August 2004.

NAPL Extraction

A total of 23.3 gallons of LNAPL was manually extracted during the reporting period using disposable bailers. A total of 103.7 gallons of DNAPL was extracted using pneumatic pumps during the reporting period. A total of 34.1 gallons of DNAPL was extracted using the automated extraction system during the reporting period. During extraction, a certain percentage of groundwater is inadvertently removed as part of the extraction process. E & E has observed that the quantity of groundwater has been steadily increasing with each reporting period during DNAPL extraction. Previously NAPL volume was not corrected for percentage of water, but the NAPL extraction values listed in Table 5 have been corrected and are therefore based on total gallons of NAPL. The total extracted volume listed above also accounts for the approximate corrected volume. Table 5 lists the NAPL thickness and extracted values recorded for individual wells during this reporting period.

3.2 Seep Visual Inspection and Monitoring

Visual inspections of seep areas were not conducted during the reporting period due to current construction activities. Visual inspections will not be conducted during construction activities but will continue following the completion of the sediment cap installation.

4.0 Summary Observations

Shallow aquifer water levels on the inside of the wall located in the TFA are typically higher than shallow water levels on the inside of the wall located in the FWDA. Flow is generally from the TFA to the FWDA. This is consistent with previous monitoring periods. Water level elevations within the barrier wall are slowly decreasing, which we would expect to observe during the summer season. Water levels will continue to be monitored and reported on a monthly basis.

NAPL monitoring and extraction will continue on a weekly basis, and patterns of NAPL appearance and rebound will be noted and used to optimize removal activities. Select monitoring wells have been included in an automated DNAPL extraction system and if feasible DNAPL extraction will be conducted on a daily basis. Observed NAPL thicknesses and occurrence during the reporting period were fairly consistent with the previous reporting period with the exception of those wells on the extraction system.

Table 1
Monitoring Well Network
McCormick and Baxter Creosoting Company Site
Portland, Oregon

Well Identification	Monitoring Frequency	Measurement Method	Screen Interval (feet NGVD)
Existing Wells			
EW-1s	Weekly	Manual/NAPL Gauge	14.11 to -10.89
EW-2s	Weekly	Manual/NAPL Gauge	17.06 to -7.94
EW-5s	Weekly	Manual/NAPL Gauge	5.98 to -4.02
EW-8s	Weekly	Manual/NAPL Gauge	4.76 to -15.24
EW-9s	Weekly	Manual/NAPL Gauge	3.51 to -6.49
EW-10s	Weekly	Manual/NAPL Gauge	5.61 to -14.39
EW-12s	Weekly	Manual/NAPL Gauge	18.06 to -1.94
EW-14R	Weekly	Manual/NAPL Gauge	-15.00 to -35.00
EW-15s	Weekly	Manual/NAPL Gauge	12.92 to -7.08
EW-16R	Weekly	Manual/NAPL Gauge	12.68 to -7.32
EW-17s	Weekly	Manual/NAPL Gauge	13.04 to -6.96
EW-18s	Weekly	Manual/NAPL Gauge	14.74 to -5.26
EW-19s	Weekly	Manual/NAPL Gauge	*9.64 to -9.5*
EW-22s	Weekly	Manual/NAPL Gauge	16.51 to -3.49
EW-23s	Weekly	Manual/NAPL Gauge	13.30 to -6.70
EW-24s	Weekly	Manual/NAPL Gauge	15.49 to -4.51
MW-20i	Weekly	Manual/NAPL Gauge	-15.50to -35.50
MW-34i	Weekly	Manual/NAPL Gauge	-33.93 to -53.93
MW-36d	Hourly	Pressure Transducer	-55.2 to -60.20
MW-36i	Hourly	Pressure Transducer	-21.1141 to -26.11
MW-36s	Hourly	Pressure Transducer	13.75 to -1.25
MW-37d	Hourly	Pressure Transducer	-55.26 to -60.26
MW-37i	Hourly	Pressure Transducer	-20.17 to -25.17
MW-37s	Hourly	Pressure Transducer	8.01 to -6.99
MW-40d	Hourly	Pressure Transducer	-54.51 to -59.51
MW-40i	Hourly	Pressure Transducer	-20.42 to -25.42
MW-40s	Hourly	Pressure Transducer	13.61 to -1.39
MW-41d	Hourly	Pressure Transducer	-55.84 to -60.84
MW-41i	Hourly	Pressure Transducer	-21.80 to -26.80
MW-41s	Hourly	Pressure Transducer	12.44 to -2.56
MW-44d	Hourly	Pressure Transducer	-55.54 to -60.54
MW-44i	Hourly	Pressure Transducer	-20.64 to -25.64
MW-44s	Hourly	Pressure Transducer	12.59 to -2.41
MW-45d	Hourly	Pressure Transducer	-56.54 to -61.54
MW-45i	Hourly	Pressure Transducer	-20.51 to -25.51
MW-45s	Hourly	Pressure Transducer	11.95 to-3.05
MW-50s	Hourly	Pressure Transducer	15.87 to 0.87
MW-51s	Hourly	Pressure Transducer	16.42 to 1.42
MW-54s	Hourly	Pressure Transducer	17.53 to 2.53
MW-55s	Hourly	Pressure Transducer	17.26 to 2.26
MW-56s	Weekly	Manual/NAPL Gauge	18.17 to 3.17
MW-58d	Hourly	Pressure Transducer	-46.39 to -51.59
MW-58s	Hourly	Pressure Transducer	17.79 to 2.79
MW-Ds	Weekly	Manual/NAPL Gauge	7.34 to 2.34
MW-Es	Weekly	Manual/NAPL Gauge	16.85 to -3.15
MW-Gs	Weekly	Manual/NAPL Gauge	14.05 to -5.95
MW-Ni	Weekly	Manual/NAPL Gauge	-22.48 to -33.48
MW-Rs	Weekly	Manual/NAPL Gauge	16.30 to 1.30
EW-25s	Low Tide Event	Manual	20.90 to .90

Table 1
Monitoring Well Network
McCormick and Baxter Creosoting Company Site
Portland, Oregon

Well Identification	Monitoring Frequency	Measurement Method	Screen Interval (feet NGVD)
MW-10s	Low Tide Event	Manual	18.17 to -1.83
MW-11s	Low Tide Event	Manual	16.62 tp -3.38
MW-14s	Low Tide Event	Manual	14.83 to -5.17
MW-15s	Low Tide Event	Manual	22.56 to 2.56
MW-17s	Low Tide Event	Manual	18.75 to -1.25
MW-18s	Low Tide Event	Manual	14.26 to -5.74
MW-1s	Low Tide Event	Manual	8.66 to -11.34
MW-22i	Low Tide Event	Manual	-9.84 to -19.84
MW-23d	Low Tide Event	Manual	- 139.72 to -149.72
MW-2s	Low Tide Event	Manual	17.73 to -2.27
MW-32i	Low Tide Event	Manual	-14.70 to -24.70
MW-33s	Low Tide Event	Manual	13.95 to 3.95
MW-35s	Low Tide Event	Manual	9.74 to -10.26
MW-38d	Low Tide Event	Manual	-54.75 to -59.75
MW-38i	Low Tide Event	Manual	-19.76 to -24.76
MW-38s	Low Tide Event	Manual	13.11 to -1.89
MW-39d	Low Tide Event	Manual	-55.22 to -60.22
MW-39i	Low Tide Event	Manual	-20.49 to -25.49
MW-39s	Low Tide Event	Manual	12.15 to -2.85
MW-3s	Low Tide Event	Manual	17.36 to -2.64
MW-42d	Low Tide Event	Manual	-54.63 to -59.63
MW-42i	Low Tide Event	Manual	-19.15 to -24.15
MW-42s	Low Tide Event	Manual	17.40 to 2.40
MW-43d	Low Tide Event	Manual	-55.4 to -60.40
MW-43i	Low Tide Event	Manual	-20.32 to -25.32
MW-43s	Low Tide Event	Manual	16.12 to 1.12
MW-46s	Low Tide Event	Manual	15.88 to 0.88
MW-47s	Low Tide Event	Manual	16.48 to 1.48
MW-48s	Low Tide Event	Manual	14.60 to -0.40
MW-49s	Low Tide Event	Manual	13.91 to -1.09
MW-52s	Low Tide Event	Manual	11.75 to -3.25
MW-53s	Low Tide Event	Manual	11.62 to -3.38
MW-57s	Low Tide Event	Manual	17.97 to 2.97
MW-58i	Low Tide Event	Manual	-12.14 to -17.14
MW-5s	Low Tide Event	Manual	22.03 to 2.03
MW-7s	Low Tide Event	Manual	15.31 to -4.69
MW-7-WC	Low Tide Event	Manual	11.46 to -3.54
MW-8i	Low Tide Event	Manual	-10.45 to -30.45
MW-As	Low Tide Event	Manual	11.70 to 6.70
MW-Cs	Low Tide Event	Manual	13.96 to 8.96
MW-Is	Low Tide Event	Manual	18.17 to -1.83
MW-Js	Low Tide Event	Manual	19.95 to -0.05
MW-Ks	Low Tide Event	Manual	20.50 to 0.50
MW-LRs	Low Tide Event	Manual	17.87 to -2.03
MW-Os	Low Tide Event	Manual	20.12 to -1.88
PW-1d	Low Tide Event	Manual	-31.60 to -90.60
PW-2d	Low Tide Event	Manual	-31.96 to -51.96

Notes:
italic text = approximate value

DRAFT

Table 2
GROUNDWATER AND LNAPL ELEVATIONS
August 18, 2004
McCORMICK & BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

Well ID	TIME	Measuring Point	Measuring Point Elevation	Depth to LNAPL	LNAPL Elevation	LNAPL Thickness	Depth to Water	GW Elevation	GW Elevation LNAPL corrected	Specific Gravity of NAPL
EW-10s	16:32	IC	22.90	19.2	3.70	1.52	20.72	2.18	3.68	0.98135
EW-12s	17:35	IC	34.19	22.67	11.52	0.01	22.68	11.51	11.52	0.98135
EW-14R	16:04	IC	36.35				27.78	8.57		
EW-15s	16:59	IC	37.70	29.18	8.52	3.10	32.28	5.42	8.48	0.9887
EW-16R	17:02	OC	36.75				27.88	8.87		
EW-17s	17:24	IC	34.91				23.63	11.28		
EW-18s	17:21	IC	35.42	24.11	11.31	1.23	25.34	10.08	11.27	0.974
EW-19s	16:30	IC	19.29	14.77	4.52	0.01	14.78	4.51	4.52	0.98135
EW-1s	17:32	OC	32.88	21.41	11.47	0.01	21.42	11.46	11.47	0.98135
EW-22s	16:49	IC	38.48				33.24	5.24		
EW-23s	16:56	IC	35.18	27.39	7.79	1.85	29.24	5.94	7.75	0.98135
EW-24s	17:15	IC	35.04				23.81	11.23		
EW-25s	17:19	IC	33.19				21.59	11.60		
EW-2s	16:43	OC	35.19				30.12	5.07		
EW-5s	17:26	OC	33.66				22.22	11.44		
EW-8s	17:19	OC	34.74	23.43	11.31	0.01	23.44	11.30	11.31	0.98135
EW-9s	16:49	IC	37.38				32.69	4.69		
MW-10s	16:59	IC	33.91				22.18	11.73		
MW-11s	17:02	IC	33.52				22.12	11.40		
MW-14s	17:07	IC	33.47				22.59	10.88		
MW-15s	16:41	IC	34.87				24.32	10.55		
MW-17s	16:44	IC	33.54				23.17	10.37		
MW-18s	16:37	IC	39.75				34.46	5.29		
MW-2s	17:11	IC	31.59				24.01	7.58		
MW-20i	16:40	OC	35.03	31.41	3.62	0.03	31.44	3.59	3.62	0.999
MW-22i	16:58	IC	33.85				29.29	4.56		
MW-23d	16:55	OC	33.38				28.57	4.81		
MW-32i	17:37	IC	33.25				26.32	6.93		
MW-33s	17:12	IC	35.61				27.02	8.59		
MW-34i	16:35	IC	23.62				19.95	3.67		
MW-36s	16:21	IC	23.57				15.62	7.95		
MW-36i	16:22	IC	22.59				18.64	3.95		
MW-36d	16:23	IC	22.31				18.6	3.71		
MW-37s	16:25	IC	17.75				13.16	4.59		
MW-37i	6:14	IC	17.51				13.77	3.74		
MW-37d	16:27	IC	17.28				13.59	3.69		
MW-38s	16:30	IC	23.04				14.24	8.80		
MW-38i	16:31	IC	23.06				18.95	4.11		
MW-38d	16:32	IC	22.90				19.14	3.76		
MW-39s	16:34	IC	22.02				17.16	4.86		
MW-39i	16:35	IC	22.39				18.67	3.72		
MW-39d	16:35	IC	22.55				18.83	3.72		
MW-3s	17:07	IC	27.20				17.29	9.91		
MW-40s	16:37	IC	23.40				13.53	9.87		
MW-40i	16:39	IC	23.24				19.07	4.17		
MW-40d	16:39	IC	23.08				19.28	3.80		
MW-41s	16:41	IC	22.26				17.37	4.89		
MW-41i	16:41	IC	22.04				18.06	3.98		
MW-41d	16:42	IC	22.05				18.28	3.77		
MW-42s	16:48	IC	35.02				24.41	10.61		
MW-43s	16:47	IC	33.95				29.62	4.33		
MW-44s	16:56	IC	23.07				11.72	11.35		
MW-44i	16:57	IC	23.19				18.53	4.66		
MW-44d	16:57	IC	22.91				19.03	3.88		
MW-45s	16:59	IC	22.43				17.59	4.84		
MW-45i	17:01	IC	22.07				17.76	4.31		
MW-45d	16:59	IC	21.93				18.04	3.89		
MW-46s	16:49	IC	34.20				22.76	11.44		
MW-47s	16:50	IC	34.74				29.68	5.06		
MW-48s	17:17	IC	33.02				20.64	12.38		
MW-49s	17:15	IC	32.19				19.8	12.39		
MW-50s	18:25	IC	34.26				21.64	12.62		
MW-51s	17:06	IC	34.71				22.25	12.46		
MW-52s	17:21	IC	35.09				23.86	11.23		
MW-53s	17:22	IC	35.12				23.53	11.59		
MW-54s	17:09	IC	35.85				24.8	11.05		
MW-55s	17:10	IC	35.57				27.11	8.46		

Note: LNAPL correction is calculated by: (LNAPL thickness x specific gravity) + groundwater elevation

Table 2
GROUNDWATER AND LNAPL ELEVATIONS
August 18, 2004
McCORMICK & BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

Well ID	TIME	Measuring Point	Measuring Point Elevation	Depth to LNAPL	LNAPL Elevation	LNAPL Thickness	Depth to Water	GW Elevation	GW Elevation LNAPL corrected	Specific Gravity of NAPL
MW-56s	17:07	IC	36.42	28.38	8.04	0.46	28.84	7.58	8.03	0.98135
MW-57s	16:39	IC	36.36				30.77	5.59		
MW-58s	16:20	IC	38.06				33.11	4.95		
MW-58i	16:23	IC	37.54				33.5	4.04		
MW-58d	16:22	IC	37.98				34.3	3.68		
MW-5s	16:53	IC	31.66				20	11.66		
MW-7s	16:53	IC	32.56				21.27	11.29		
MW-7WC	16:29	IC	33.24				26.46	6.78		
MW-8i	16:54	IC	32.09				27.66	4.43		
MW-As	17:35	IC	34.76				22.29	12.47		
MW-Cs	17:05	IC	36.29				25.28	11.01		
MW-Ds	16:45	OC	37.60	32.47	5.13	0.01	32.48	5.12	5.13	0.98135
MW-Es	17:05	IC	37.72	28.91	8.81	1.23	30.14	7.58	8.79	0.98135
MW-Gs	16:35	IC	32.69	27.73	4.96	0.21	27.94	4.75	4.96	0.98135
MW-Is	17:30	IC	33.14	21.61	11.53	0.01	21.62	11.52	11.53	0.98135
MW-Js	17:19	IC	35.42				24.32	11.10		
MW-Ks	17:15	IC	36.51				27.21	9.30		
MW-LRs	16:51	IC	33.93				22.79	11.14		
MW-Os	17:29	IC	34.61				22.03	12.58		
MW-Rs	17:13	IC	32.98	21.88	11.10	3.39	25.27	7.71	11.04	0.98135
PW-1d	17:33	OC	36.26				29.27	6.99		
PW-2d	17:30	OC	35.85				28.81	7.04		

Note: LNAPL correction is calculated by: (LNAPL thickness x specific gravity) + groundwater elevation

Table 3

GROUNDWATER ELEVATION GRADIENTS
McCORMICK & BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

Well ID	Date	Horizontal Distance (ft)	Horizontal Gradient (ft/ft)
Inside Barrier Wall			
MW-50s to MW-36s	8/18/2004 (Low Tide)	1090.4	0.004
TFA Monitoring Wells			
12' to 11' Contour	8/18/2004 (Low Tide)	742.5	0.001
FWDA Monitoring Wells			
MW-15s to MW-36s	8/18/2004 (Low Tide)	400.4	0.007
11' to 8' Contour	8/18/2004 (Low Tide)	435.0	0.007
Outside Barrier Wall			
MW-45s to River[1]	8/18/2004 (Low Tide)	80.0	0.016
FWDA Monitoring Wells			
MW-57s to MW-58s	8/18/2004 (Low Tide)	30.0	0.022

Note:

[1] The distance from the Willamette River to the well is the corresponding ground surface elevation for the river stage at low tide (3.5 NGVD), perpendicular from MW-45s to the river.

Key:

ft = Feet.
ft/ft = Feet per foot.
FWDA = Former waste disposal area.
MSL = Mean sea level.
TFA = Tank farm area.

Table 4
VERTICAL GROUNDWATER ELEVATION GRADIENTS
8/18/2004 at low tide
McCORMICK & BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

Well ID	Manual Measurements Mid-point value (ft/ft)	Transducer Measurements Mid-point value (ft/ft)	Direction	Well ID	Manual Measurement Times	Transducer Measurement Times
MW-36s to MW-36d	0.070	0.069	down	MW-36d	16:23	16:25
MW-36s to MW-36i	0.148	0.148	down	MW-36i	16:22	16:30
MW-36i to MW-36d	0.007	0.006	down	MW-36s	16:21	16:20
				MW-37d	16:27	16:46
MW-37s to MW-37d	0.016	0.016	down	MW-37i	16:26	16:36
MW-37s to MW-37i	0.040	0.035	down	MW-37s	16:25	16:32
MW-37i to MW-37d	0.001	0.004	down	MW-40d	16:39	16:50
				MW-40i	16:39	17:05
MW-40s to MW-40d	0.099	0.100	down	MW-40s	16:37	16:56
MW-40s to MW-40i	0.210	0.208	down	MW-41d	16:42	16:55
MW-40i to MW-40d	0.011	0.014	down	MW-41i	16:41	16:44
				MW-41s	16:41	16:56
MW-41s to MW-41d	0.019	0.015	down	MW-44d	16:57	16:28
MW-41s to MW-41i	0.036	0.036	down	MW-44i	16:57	17:15
MW-41i to MW-41d	0.006	0.000	down; up	MW-44s	16:56	17:22
				MW-45d	16:59	17:17
MW-44s to MW-44d	0.120	0.118	down	MW-45i	17:01	17:12
MW-44s to MW-44i	0.243	0.245	down	MW-45s	16:59	17:06
MW-44i to MW-44d	0.022	0.018	down			
MW-45s to MW-45d	0.016	0.017	down			
MW-45s to MW-45i	0.022	0.024	down			
MW-45i to MW-45d	0.012	0.012	down			

Note: Gradients calculated using EPA vertical gradient calculator.
http://www.epa.gov/athens/learn2model/part-two/onsite/vgradient02.htm

DRAFT

Table 5
LNAPL DNAPL Measurement Summary
August 1 through August 31, 2004

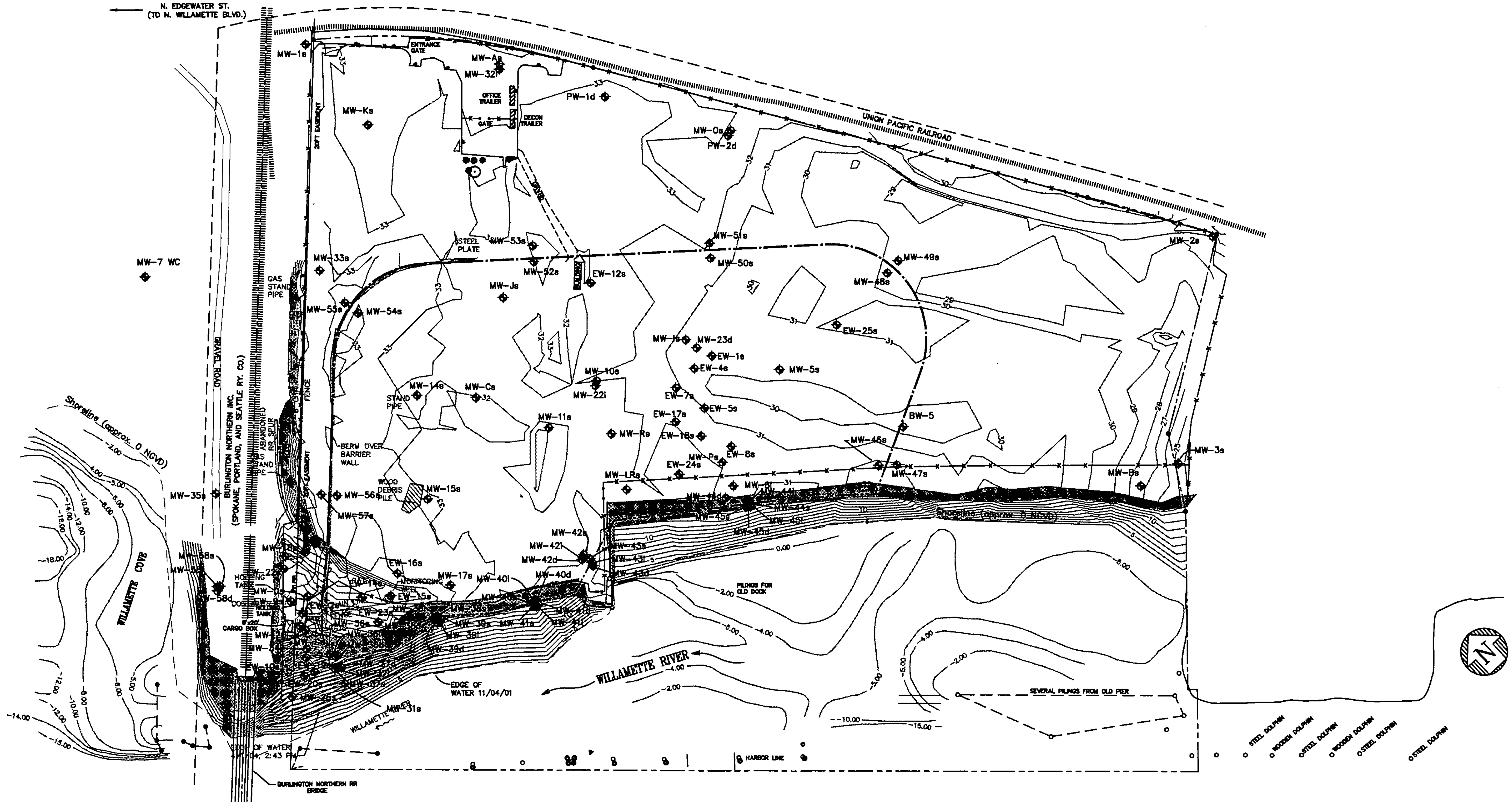
Date Measured	Well Number	Measured Thickness (feet)	Extracted (Gallons)
LNAPL			
8/2/2004	EW-10s	1.11	2.5
8/9/2004	EW-10s	1.97	3.92
8/16/2004	EW-10s	1.08	5.32
8/24/2004	EW-10s	1.43	2.52
8/30/2004	EW-10s	1.04	0
8/2/2004	EW-12s	0.01	0
8/16/2004	EW-12s	0.01	0
8/24/2004	EW-12s	0.01	0
8/30/2004	EW-12s	0.01	0
8/9/2004	EW-15s	2.28	0
8/16/2004	EW-15s	2.74	0
8/24/2004	EW-15s	3.66	3.72
8/30/2004	EW-15s	1.71	0
8/2/2004	EW-18s	1.35	2.5
8/9/2004	EW-18s	1.16	0
8/16/2004	EW-18s	1.3	3.1
8/24/2004	EW-18s	1.31	0
8/30/2004	EW-18s	1.13	0
8/2/2004	EW-19s	0.01	0
8/16/2004	EW-19s	0.01	0
8/24/2004	EW-19s	0.01	0
8/30/2004	EW-19s	0.01	0
8/16/2004	EW-1s	0.01	0
8/24/2004	EW-1s	0.26	0
8/30/2004	EW-1s	0.01	0
8/2/2004	EW-23s	1.87	3.5
8/9/2004	EW-23s	1.81	0
8/16/2004	EW-23s	1.4	0
8/24/2004	EW-23s	1.86	3.72
8/30/2004	EW-23s	1.17	0
8/24/2004	EW-8s	0.02	0
8/24/2004	EW-9s	0.29	0
8/2/2004	MW-20i	0.01	0
8/9/2004	MW-20i	0.05	0
8/16/2004	MW-20i	0.01	0
8/24/2004	MW-20i	0.01	0
8/2/2004	MW-56s	0.46	0.5
8/9/2004	MW-56s	0.57	0
8/16/2004	MW-56s	0.75	0
8/24/2004	MW-56s	0.57	0
8/30/2004	MW-56s	0.22	0
8/2/2004	MW-Ds	0.01	0
8/9/2004	MW-Ds	0.03	0
8/16/2004	MW-Ds	0.01	0
8/24/2004	MW-Ds	0.01	0
8/30/2004	MW-Ds	0.01	0

Table 5
LNAPL DNAPL Measurement Summary
August 1 through August 31, 2004

Date Measured	Well Number	Measured Thickness (feet)	Extracted (Gallons)
8/2/2004	MW-Es	0.49	0.5
8/9/2004	MW-Es	2.16	0
8/16/2004	MW-Es	2.48	0
8/24/2004	MW-Es	0.99	0
8/30/2004	MW-Es	0.85	0
8/2/2004	MW-Gs	0.01	0
8/9/2004	MW-Gs	0.46	0
8/16/2004	MW-Gs	1.47	0.964
8/24/2004	MW-Gs	0.32	0
8/30/2004	MW-Gs	0.53	0
8/9/2004	MW-Is	0.12	0
8/16/2004	MW-Is	0.01	0
8/24/2004	MW-Is	0.01	0
8/2/2004	MW-Rs	0.15	0
8/9/2004	MW-Rs	0.19	0
8/16/2004	MW-Rs	0.21	0
8/24/2004	MW-Rs	0.17	0
8/30/2004	MW-Rs	0.26	0
DNAPL			
8/9/2004	EW-12s	1.25	3.1
8/16/2004	EW-12s	1.16	0
8/24/2004	EW-12s	1.07	0
8/30/2004	EW-12s	1.04	0
8/2/2004	EW-12s	1.34	2.682
8/2/2004	EW-1s	1.37	5.96
8/9/2004	EW-1s	1.29	9.71
8/16/2004	EW-1s	1.13	0
8/24/2004	EW-1s	2.19	0
8/30/2004	EW-1s	1.12	0
8/2/2004	EW-24s	0.48	0
8/9/2004	EW-24s	0.34	0
8/16/2004	EW-24s	0.53	0
8/24/2004	EW-24s	0.24	0
8/30/2004	EW-24s	0.31	0
8/9/2004	EW-2s	0.22	0
8/16/2004	EW-2s	1.62	5.37
8/2/2004	EW-8s	2.77	4.77
8/9/2004	EW-8s	1.56	7.44
8/16/2004	EW-8s	1.41	0
8/24/2004	EW-8s	1.47	5
8/30/2004	EW-8s	1.11	0
8/9/2004	EW-9s	1.87	10
8/16/2004	EW-9s	0.69	0
8/2/2004	MW-20i	5.72	8.94
8/9/2004	MW-20i	3.47	28.92
8/16/2004	MW-20i	2.88	7.02
8/2/2004	MW-Ds	2.94	2.086

Table 5
LNAPL DNAPL Measurement Summary
August 1 through August 31, 2004

Date Measured	Well Number	Measured Thickness (feet)	Extracted (Gallons)
8/9/2004	MW-Ds	2.18	6.69
8/16/2004	MW-Ds	1.41	4.46
8/24/2004	MW-Es	0.58	0
8/9/2004	MW-Gs	1.02	7.71
8/16/2004	MW-Gs	1.15	5.78
8/2/2004	MW-Gs	1.04	1.49
8/2/2004	MW-Is	1.12	1.79
8/9/2004	MW-Is	2.71	2.48
8/16/2004	MW-Is	1.32	0
8/24/2004	MW-Is	1.19	0
8/30/2004	MW-Is	1.73	0
Treatment System DNAPL Extraction			
8/27/04, 8/30/04 and 8/31/2004	MW-Ds	2.62, 2.19 and 1.23	5.58
8/27/04, 8/30/04 and 8/31/2004	MW-20i	2.33, 1.15 and 1.07	15.28
8/27/04, 8/30/04 and 8/31/2004	MW-Gs	1.23, 3.80 and 2.89	7.64
8/27/04, 8/30/04 and 8/31/2004	EW-2s	1.79, 1.42 and 1.11	4.96
8/27/04, 8/30/04 and 8/31/2004	EW-9s	0.84, 0.84 and 0.53	0.62



Note: The BW locations are approximate.

LEGEND

Symbol	Description
⊕	WELL LOCATIONS
⊕	BORE HOLE
IIIIIIIIII	RAILROAD TRACKS
- - - - -	PROPERTY LINE
— - —	BARRIER WALL

SCALE IN FEET
0 100 200 300

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW

CHECKED BY:

DRAWN BY: E. YAO

APPROVED BY

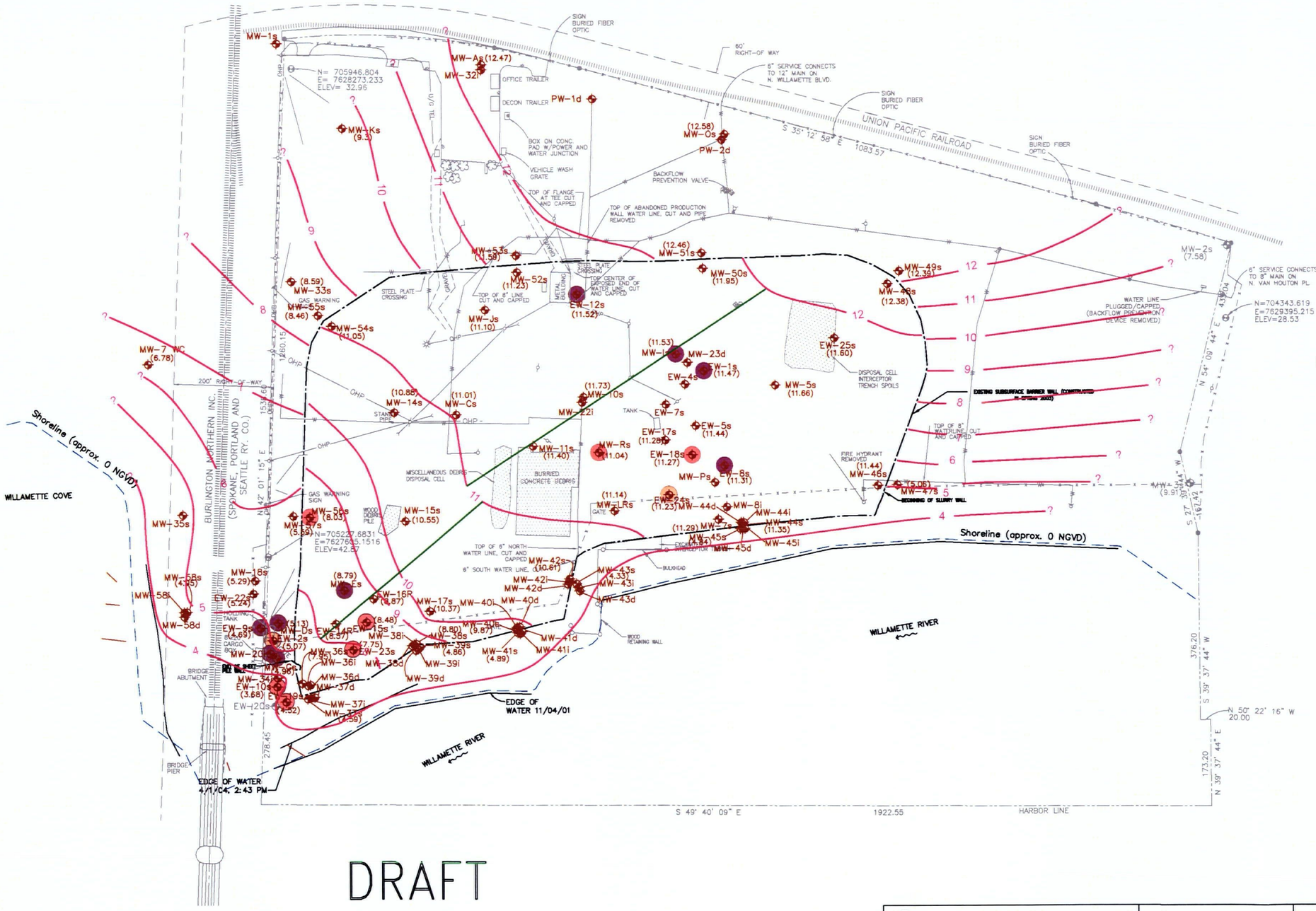
FIGURE 1

MONITORING WELL LOCATIONS

McCORMICK AND BAXTER CREOSOTING COMPANY

SCALE	DATE ISSUED	C.A.D. FILE NO.	FIGURE NO.
NOTED	05-06-04	figure1.dwg	1

BRG PLOTTED: 05-06-04



LEGEND

- WELL LOCATION
- WELL DESIGNATED WITH MEASURABLE LNAPL
- WELL DESIGNATED WITH MEASURABLE DNAPL
- WELL DESIGNATED WITH DNAPL AND LNAPL
- GROUNDWATER CONTOUR LINE
- RAILROAD TRACKS
- PROPERTY LINE
- BARRIER WALL
- SEEP LOCATION
- HORIZONTAL GRADIENT

Note: Static water levels taken between 4:00 PM and 6:00 PM.

Willamette river average elevation is 3.6 NGVD between 4:00 PM and 6:00 PM on 08–18–04.

Willamette river at low tide minimum elevation on 08–18–04 is 3.5 NGVD at 5:30 PM.

The following wells that contain LNAPL are also included in the groundwater contour information on this map : EW-12s, EW-19s, MW-1s, EW-18s, EW-15s, EW-10s, EW-23s, MW-56s, MW-Es and MW-Gs. A correction for the depression of the LNAPL/water interface was applied.

SCALE IN FEET
0 150 300

NO.	DATE	DWN	APP'D	DESCRIPTION
				REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY:
CHECKED BY:
DRAWN BY: E. YAO
APPROVED BY

Figure 2a

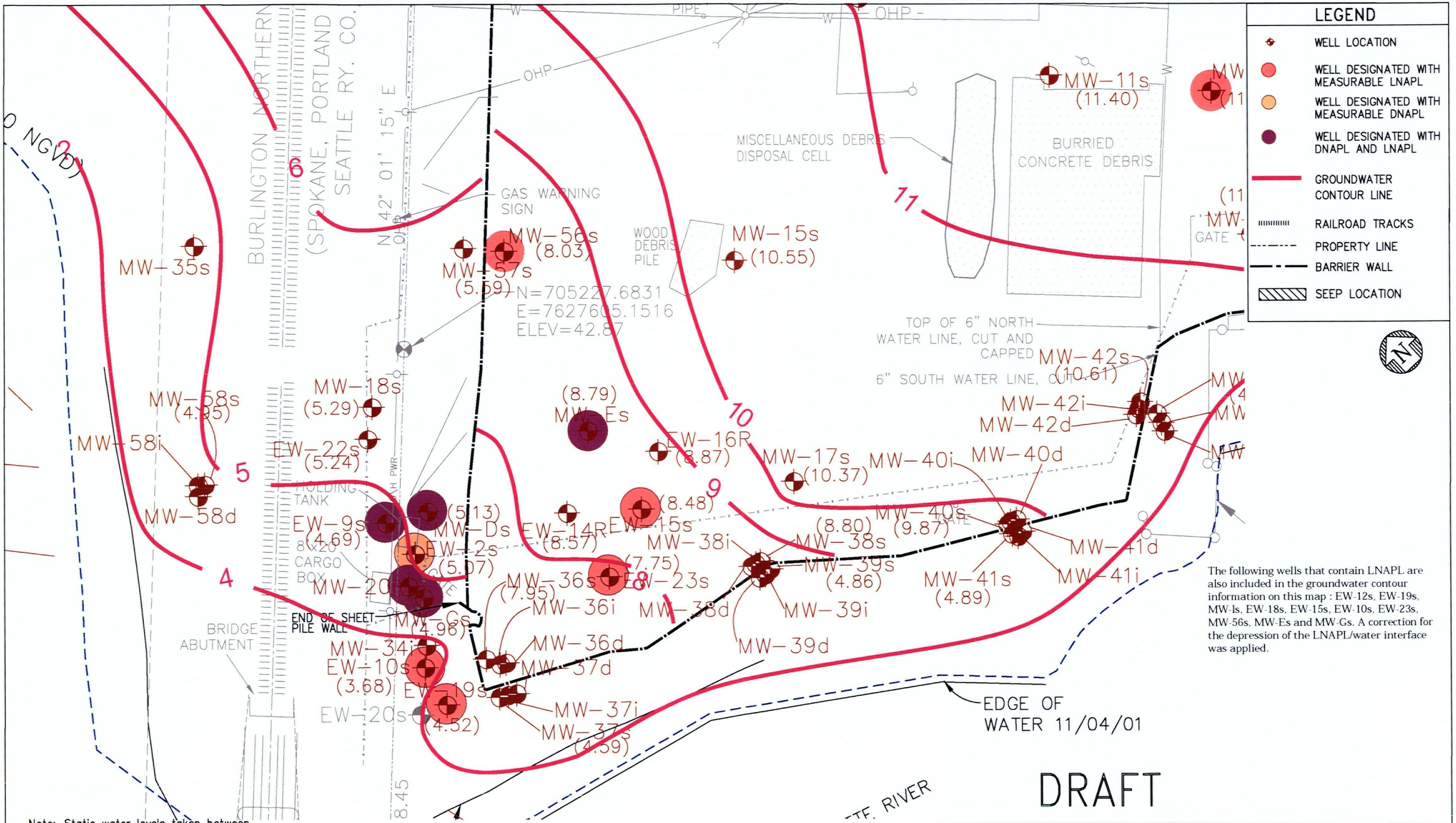
Monitoring Wells With NAPL Present and Groundwater Contours at Low Tide

McCORMICK AND BAXTER CREOSOTING COMPANY

August 18, 2004

SCALE	DATE ISSUED	C.A.D. FILE NO.	FIGURE NO.
NOTED	09-09-04	figure2a.dwg	1

BRG PLOTTED: 09-09-04



The following wells that contain LNAPL are also included in the groundwater contour information on this map : EW-12s, EW-19s, MW-1s, EW-18s, EW-15s, EW-10s, EW-23s, MW-56s, MW-Es and MW-Gs. A correction for the depression of the LNAPL/water interface was applied.

Note: Static water levels taken between 4:00 PM and 6:00 PM.

Willamette river average elevation is 3.6 NGVD between 4:00 PM and 6:00 PM on 08-18-04.

Willamette river at low tide minimum elevation on 08-18-04 is 3.5 NGVD at 5:30 PM.

SCALE IN FEET
0 50 100

NO.	DATE	BWN	APP'D	DESCRIPTION
				REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY:
CHECKED BY:
DRAWN BY: E. YAO
APPROVED BY

Figure 2b
Monitoring Wells With NAPL Present and Groundwater Contours at Low Tide FWDA Area

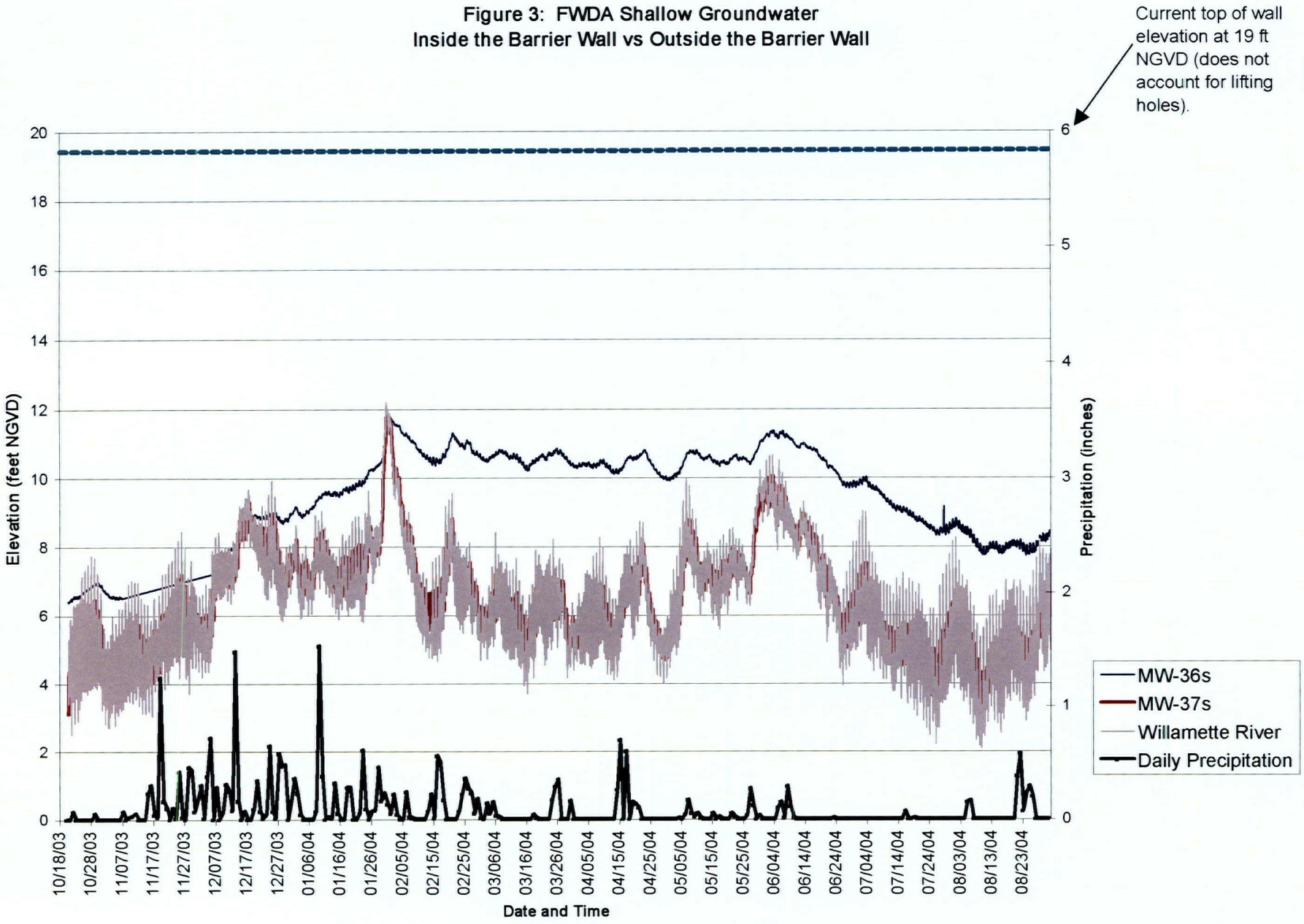
McCORMICK AND BAXTER CREOSOTING COMPANY

August 18, 2004

SCALE	DATE ISSUED	CAD FILE NO.	FIGURE NO.
NOTED	09-09-04	figure2a.dwg	1

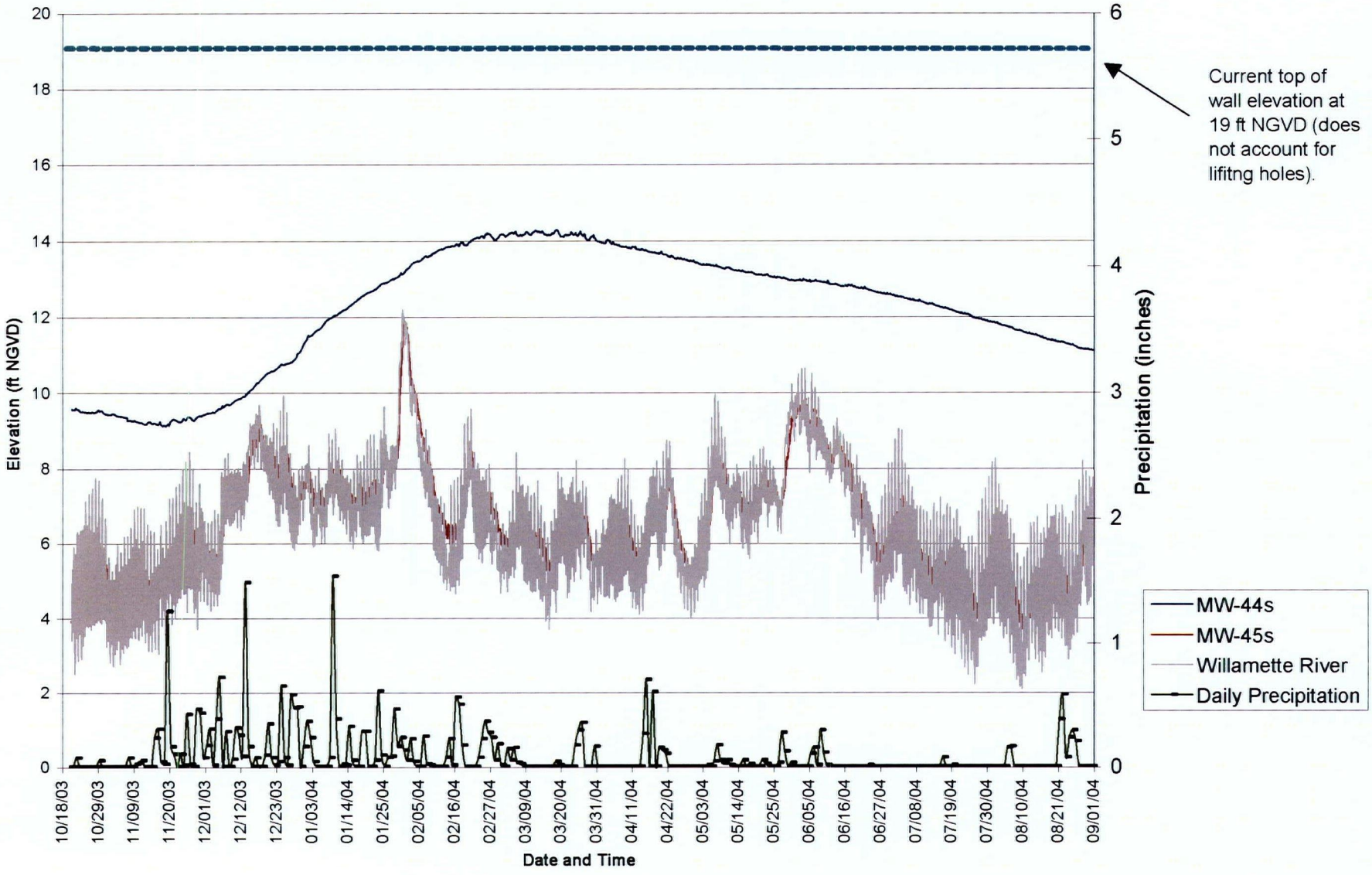
BRG PLOTTED: 09-09-04

Figure 3: FWDA Shallow Groundwater
Inside the Barrier Wall vs Outside the Barrier Wall



*Note: Precipitation data presented in this graph is obtained from the City of Portland HYDRA Rainfall Network, Swan Island raingage at http://oregon.usgs.gov/non-usgs/bes/

Figure 4: TFA Shallow Groundwater
Inside the Barrier Wall vs. Outside the Barrier Wall



Notes: Precipitation data presented in this graph is obtained from the City of Portland HYDRA Rainfall Network, Swan Island raingage, at http://oregon.usgs.gov/non-usgs/bes/